SCE3310C

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**Chapter 19 Summary**

**Sound**

**Producing and Transmitting Sound**

*Sound and Its Characteristics*

* Sound is an effect of mechanical radiation.
  + **Radiation**- movement of energy from one place to another.
  + Three types of radiation:
    - Mechanical
      * Requires a material medium to proliferate energy from one place to another.
    - Electromagnetic
    - Particle
* Sound is caused by an object that is moving back and forth, or vibrating.
  + Vibrations from the source disturb the molecules in the air and establish radiating waves of sound energy.
  + Sound vibrations can be caused by:
    - Plucking
    - Stroking
    - Blowing
    - Hitting a can
  + Sound cannot travel where there are no molecules to vibrate. i.e.- vacuum.
  + If there is a medium, i.e. air, vibrating waves move from the vibrating source in all directions.
  + 3 Factors that affect perception of sound.
    - A vibrating source- that sets up the sound waves
    - A medium- that carries waves
    - A receiver- detects waves
  + **Music**
    - Pleasant sounds, produced by regular vibrations
  + **Noise**
    - Harsh or unpleasant sounds, produced y irregular vibrations

*How Sound Travels*

* When an object, is made to vibrate, the sound energy travels out as waves in all directions.
  + **Compression -** The space in which molecules are pressed closer together.
  + **Rarefaction-** The space in which the molecules are spread farther apart.
  + **Sound Wave-** One compression and one rarefaction make up one complete sound wave or vibration, or cycle.
  + As an object vibrates back and forth, it produces cycles of compression and rarefaction, one after another.
  + How sound is measured
    - **Frequency**- the number of cycles of compression and rarefaction, one after another.
      * Frequency is measured in units called **hertz** (hz).
      * One hertz is one complete cycle
  + Presence of cycles of alternation compression and rarefaction means that the molecules of air have also been made to move back and forth, or vibrate.
  + As the molecules of air vibrate, they bump into other molecules causing them to vibrate which causes other molecules to vibrate.
  + No single vibrating molecule travels very far.
* Most sounds come to us through the atmosphere, which is composed of gases.
  + Speed of sound in air at sea level
    - About 336 meters per second (1, 100 fps)
    - Or 1 kilometer in 3 seconds (1 mi in 5 secs).
    - Warmer the air, the greater the speed of sound will be.
      * Increases about 30 cm per sec. (1 fps) for every degree rise in Fahrenheit.
      * Increases about 60 cm per sec. (2 fps) for every degree rise in Celsius.
  + Upper atmosphere sound does not travel as fast as it does at lower elevations because air high on a mountain is thinner with fewer molecules.
* Sound travels faster and farther through liquids than through gases.
* Sound travels faster and farther through hard solids than through liquids or gases.
* Soft solids are used for soundproofing because they are poor conductors (absorb sound).

*Differences in Sound*

* Humans perceive differences in sound.
* **Pitch**- related to frequency
  + Higher sound frequency= higher pitch and vice versa.
  + Human ear can only hear frequencies within a range of 20 cycles per second to 20, 000.
  + **Subsonic**
    - Frequencies lower than the human ear can hear
  + **Supersonic** or **Ultrasonic**
    - Higher than the human ear can hear. i.e. dog whistle
  + Extremely low frequencies (below 10) and extremely high frequencies (100,000) can cause physical and chemical reactions.
* **Wavelength**- distance between its compressions.
  + Equal to the velocity of sound divided b the frequency.
  + If the source of a sound is moving, such as a car’s horn while the car is speeding by, the distance between the crests of the sound waves is compressed in one direction and lengthened in the opposite direction. This compression and lengthening of a sound wave will change the frequency of the sound which is called **Doppler Effect.**
* **Intensity-** Loudness or softness of a sound.
  + NOTHING TO DO WITH PITCH.
  + Depends of **amplitude**
    - Distance the object is vibrating.
    - More energy into making sound= louder sound
    - The farther a sound travels, the softer sound becomes.
  + **Decibel-** Unit of measurement of sound intensity.
    - Whispering- 10-20
    - Talking loud- 60 decibels
    - Heavy traffic noise- 70-80
    - Thunder- 110
    - Threshold of human pain 120
    - Loudest vehicle stereos- 154
* **Quality-** difference between various musical instruments, or between different persons who are producing a similar sound.
  + Sounds can have same pitch and intensity, but appear different.
  + **Fundamental tone**- lowest sound a vibrating body produces.
  + **Overtone-** other sounds that the vibrating body produces simultaneously, but have different frequencies.
  + Quality of sounds depends of the number and strength of various overtones produced.

*Hearing Sounds*

* When sound waves reach the ear, they are changed to electrical signals that are carried by the auditory nerve to the brain, where they are then translated into what we know as sound.
* Most animals, including humans can hear a much broader frequency than they can produce.
* Animals have adapted hearing mechanisms in different ways. i.e. snake picks up sound waves with tongue.
* **Echo-** Sound wave that bounces back, or is reflected, from a hard surface such as a cliff or a wall of a building.
  + To hear an echo we must be at least 17 meters away from the reflecting surface.
  + Farther away reflecting surface, the longer it will take to hear echo.
  + Sometimes a sound wave bounces off many surfaces and produces a series of echoes.
  + Unwanted echoes can be prevented or reduced in several ways.
    - Soft drapes, window frames, and rugs absorb sound waves and prevent echoes.
    - Covering ceilings and walls with rough materials or materials with may little holes can break up sound waves so that few reflect back to cause echoes.
  + Sound waves can be absorbed by people in an auditorium, thus reducing echo.

*Voice*

* **Larynx** or voice box is at the top of the windpipe, or trachea, in your throat.
  + Vocal Cords- two thin but strong bands of tissue stretched over top of larynx.
  + When air from the lungs is blown through a narrow slit (glottis) between these two cords, the cords are made to vibrate by the moving air and sound is produced.
* Muscles attached to vocal cords make the cords tight or loose and this controls pitch.
  + Tighter vocal cords- faster vibration and higher pitch
  + Greater force that air is blown- louder the sound
* Men’s vocal cords are usually longer and thicker than women’s and so do not vibrate as fast.
  + Men usually have lower or deeper voices than woman.
  + Young men’s vocal cords get longer with age.
* Factors that affect quality of a person’s voice.
  + Strength and control of vocal cords.
  + Air passages in the throat, mouth, and nose, as well as the sinuses of the head, also affect the quality of the voice.
    - Passages that are opened wide and are free of mucus give a better voice quality than passages that are occluded and less open.
  + The position of the lips, tongue, and teeth also functions in determining the kid and quality of sounds produced.

**Musical Instruments**

* Are devices used to produce pleasant sounds of different pitch, intensity, and quality
  + Categories- stringed, wind, and percussion.
* **Stringed Instruments-** contain one or more strings that are made vibrate in different ways to produce musical sounds.
  + Some strings are stroked or rubbed with a bow.
    - Violin, cello, bass viol.
  + Some strings are plucked
    - Ukulele, guitar, banjo, and harp.
    - In the piano, small hammers strike the strings.
  + The pitch, or frequency, of all the musical sounds produced by stringed instruments can be changed in three different ways.
    - The looser the string, the lower the pitch and vice versa
    - The longer the string, the lower the pitch; vice versa
    - The thicker the string, the lower the pitch; vice versa

Stringed instruments

* + - Have just a few strings that are attached to pegs.
    - The strings are of different thickness that produce sounds of higher and lower pitch.
    - Pegs can be used to tighten or loosen the strings.
    - When these instruments are played, the fingers move up and down the vibrating strings, making them longer and shorter.
  + Instruments such as the harp and the piano have a great many strings.
    - Strings differ in length, thickness, and tightness to produce different pitch.
  + Sounds from stringed instruments can be made louder or softer.
    - The harder a string is bowed or plucked, the more strongly it vibrates and the louder the sound. And vice versa
  + The vibrating instrument makes the air surrounding the instrument vibrate at the same frequency as well.
  + Some instruments, have openings to airspace within them.
  + **Resonance-** reinforcement of the original vibrations to make the sound louder.
  + Sounds made by stringed instruments differ in quality.
  + **Fundamental tone-** tone produced when a string vibrates, and the whole string vibrates.
  + A vibrating string can vibrate not only as a whole, but also in parts at the same time.
  + Quality of sound depends on the number and strength of the overtones that are produced.

Wind Instruments

* Contain a column of air that is made to vibrate to produce musical sounds.
  + Air can be made to vibrate by blowing on it (clarinet, saxophone, trumpet) or by blowing across it (flute, piccolo)
  + Divided into two classes- woodwind and brass.

Woodwind

* + In all woodwind instruments, except the flute and piccolo, a thin piece of wood called a reed is used to make the air column vibrate.
  + The reed is in the mouth piece.
    - Blowing into the mouthpiece makes the reed vibrate,, which then makes the air column vibrate.
  + In the flute, and piccolo, you blow across a hole to start the air column vibrating.
  + Examples- flute, piccolo, clarinet, oboe, bassoon, and English horn.

Brass Instruments

* + Are made of brass instruments and played by vibrating the lips while they are pressed against the mouthpiece of the instrument.
  + Examples- saxophone, trumpet, cornet, bugle, trombone, French horn, and tuba.
  + Are controlled by valves that control the length of the air column. The trombone is controlled by a slide.
  + The tightness of the lips and the force of the breath create different pitches.

Percussion Instruments

* Are made of solid materials, such as wood and metal, or materials stretched over a hollow container.
* Struck by mallets, hammers, or the hands, which make the materials vibrate and produce sounds.
* Percussion instruments made of solid materials include the xylophone, glockenspiel, triangle, cymbals, chimes, bells, castanets, and wood block.
* Percussions instruments made of material stretched over a hollow container include the bongo drum, snare drum, bass drum, kettledrum, and tambourine.
* In solid material percussions, the longer the material, the lower the pitch, and the shorter the material, the higher the pitch.
* In percussion instruments made of material stretched over a hollow container, pitches can be changed in different ways.
  + The tighter the covering, the higher the pitch, and the looser the covering, the lower the pitch.
  + The thinner the covering, the higher the pitch, and the thicker the covering, the lower the pitch.
  + The smaller the diameter of the instrument, the higher the pitch, and the larger the diameter, the lower the pitch.
* Striking the instrument harder produces a louder sound.

Exploring Activities for Sound (pgs 482-485)

* Exploring the Production and Transmission of Sound
  + Sound is Produce by Vibrating Objects
  + How Sound Travels
  + Sound Travels in All Directions
  + Sound Travels by Means of Compression and Rarefaction of Molecules
  + Sounds Travels Through Solids
  + Sound Travels Through Liquids
  + Sound Travels Through Gases
  + Sound Does Not Travel Through a Vacuum
  + Investigate Pitch
  + Sound Quality
  + Exploring the Voice
* Exploring Music and Musical Instruments
  + Comparing Music and Noise
  + Forced Vibrations Increase the Intensity of Sounds
  + How the Pitch is Changed in Stringed Instruments
  + Changing the Pitch in Wind Instruments
  + Changing the Pitch in Percussion Instruments
* Make the Musical Instruments